NEST BOX USE AND REPRODUCTIVE BIOLOGY OF THE AMERICAN KESTREL IN LASSEN COUNTY, CALIFORNIA

by
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Abstract

During 1976 we implemented an American Kestrel (*Falco sparverius*) nest box program in the Great Basin of Lassen County, California. The primary goal was the creation of nesting habitat where no habitat existed, and the reestablishment of such habitat where it had been eliminated. Of 247 functional nest boxes examined between 1977 and 1980, 31% of these were active and 82% of these were successful. 3.1 young were fledged per active nest box. With careful placement of nest boxes, the percent active may be increased to more than 50%.

Introduction

Despite its widespread occurrence in California, the American Kestrel has received relatively little study in the state. Except for the major ecological study by Balgooyen (1976) and on seasonal weight variation (Bloom 1973), habitat partitioning (Koplin 1973), winter territoriality (Cade 1955), and predatory efficiency (Collopy 1973), basic natural history information is lacking for most of California.

In 1976 we implemented an American Kestrel management-study program in Lassen County, California. The objectives were, 1) to determine if kestrels would nest in artificial nest boxes in areas which lacked suitable natural nest sites, and 2) to investigate the species' reproductive biology. Data were collected over 4 breeding seasons (1977 - 1980).

Study Area

The study area covered about 900 km^2 of the Great Basin in Lassen County, California. Elevation ranged from 1,260 to 2,340 m. The dominant plant association was western juniper *(Juniperus occidentalis)* and big sagebrush *(Artemesia tridentata)*. Other sub-dominant plant associations included ponderosa pine *(Pinus ponderosa)*, white fir *(Abies concolor)*, and the greasewood-shadscale complex *(Sarcobatus vermiculatus, Atriplex confertifolia)*.

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Methods

Nest box design followed Hamerstrom, et al. (1973), with modifications to meet dimensions of natural nest cavities (Fig. 1). Nest boxes were constructed of 1.9 cm thick pine and measured 18 cm deep, 20 cm wide and 33 cm tall inside. The hole was 7.6 cm in diameter and located 7.6 cm from the top, in the middle of the front of the box. The back of the box extended 5 cm above the top and 5 cm below the bottom and was fastened to the supporting structure by one nail through each extension. Boxes were placed 2 to 6 m above ground and faced all directions.

The top of each nest box was completely removeable and fastened on by eye hooks. This was later modified by bending the hook or by wiring the lid to the box since some nest boxes were later found without tops. Presumably they were blown off or sun warped. Nest boxes without tops were rendered useless; no birds of any species ever used them.

The juniper-big sagebrush habitat was chosen as the primary habitat for nest box placement because kestrel nesting densities were believed low and junipers made logical support structures for nest boxes. Junipers do not readily form natural cavities by limb breakage or rot; thus, kestrels relied primarily on woodpeckers, particularly the Common Flicker (*Colaptes auratus*), to excavate their nest holes.

Much of the Great Basin juniper country is composed of relatively young trees (Burkhardt et al. 1976). Generally, if large mature junipers are not present, Common Flickers are also limited in their choice of nest trees; thus, large areas may be devoid of suitable nest trees for either species.

Although the majority of nest boxes were placed on western junipers some nest boxes were placed on white fir, ponderosa pine, aspen (*Populus tremuloides*), cottonwood (*Populus trichocarpa*), and telephone poles to determine site preferences.

Figure 1. American Kestrel nest box in western juniper, Lassen County, California.

Results

Ninety-six nest boxes were erected during autumn 1976. Since this study was conducted supplementary to a general wildlife inventory of Lassen County, it was not always possible to check all boxes each year thereafter; 71 were checked in 1977, 67 in 1978, 49 in 1979, and 60 in 1980. Reproductive data are given in Table 1. Of the 247 boxes examined in all years, 35 lost tops, 1 had fallen from the tree, 2 had been vandalized (shotgunned), and the bottom of 1 box was destroyed by a Common Flicker. These 39 boxes were considered nonfunctional and not used in Table 1. Seven functional boxes were used by rodents, 5 by woodrats (*Neotoma* spp.), and 2 by Douglas squirrels (*Tamiasciurus douglasii*).

TABLE I

American Kestrel Nest Box Use and Reproductive Biology
Lassen, County, California

	1977	1978	1979	1980	TOTAL
Number of Boxes Examined	71	67	49	60	247
Number of Boxes Functional	65	53	40	50	208
Number (Percent) Active	14(%)	18 (34%)	14(%)	19(38%)	65(31%)
Number (percent) Successful	12(86%)	15(83%)	13(93%)	13(68%)	53(83%)
Average Clutch Size/	3.5	4.9	4.3	4.2	4.3
Box[1]/	6 boxes	14	7	11	38
Hatching Success[1]/	(81%)	(83%)	(83%)	(70%)	(79%)
	17/21	52/63	25/30	30/43	124/157
Average Brood Size/	2.8	4.7	4.2	3.8	4.0
Box[1]/	6 boxes	11	6	8	31
Fledging Success	(88%)	(88%)	(100%)	(87%)	(90%)
	15/17	46/52	25/25	26/30	112/124
Number of Young Fledged/	2.5	4.6	4.1	3.2	3.7
Successful Box[1]/	6 boxes	10	6	8	30
Number of Young Fledged/	2.5	3.5	3.6	2.6	3.1
Active Box[1]/	6 boxes	13	7	10	36

[1]/ Data not available from all nests in all years.

An additional 33 nest boxes were occupied by other species of birds. These included Bufflehead (*Bucephala albeola*), Flammulated Owl (*Otus flammeolus*), Common Flicker, Tree Swallow (*Iridoprocne bicolor*), Mountain Chickadee (*Parus gambeli*), House Wren (*Troglodytes aedon*), Mountain Bluebird (*Sialia currucoides*), Starling (*Sturnus vulgaris*) and House Finch (*Carpodacus mexicanus*).

A nest box was considered to be active (used by kestrels) if eggs, young, or evidence of nesting (eggshells, etc.) were found. The box was considered successfuf if it fledged at least 1 young.

Reproductive Biology

Biases may be present in some reproductive data since most boxes were not observed during the incubation period, and not all were reexamined to determine actual fledging success. Clutch size may thus be biased on the low side, and fledging success on the high side. However, 20 nests contained the maximum clutch or brood size observed, and since clutch sizes larger than 5 are rare, we believe that these represent complete clutches. Unhatched eggs were frequently found in the boxes along with young, allowing original clutch sizes to be calculated. For example, if an initial visit showed that 5 eggs were present, and on a later visit the box contained 4 young, the mortality was attributed to the nestling stage. Although the remains of some larger nestlings were found in the nest boxes, very small young may have disappeared without a trace due to cannibalism, or being consumed by the dermestid beetle larvae which often infest the box bottom. Although not documented, such losses would have similarly biased clutch size on the low side and fledgling success on the high side.

Incubation period was assumed to be 30 days (Brown and Amadon 1968). Hatching success was derived by dividing the number of eggs laid into the number that hatched and multiplying by 100, while fledging success was determined by dividing the number of young fledged by the number hatched and multiplying by 100.

Age of the young was estimated on the basis of body size and feather development. We believe that ages assigned to young were accurate to within 3 days. Average egg laying and hatching dates were derived by back dating from the estimated average age of the young in each brood. The dates on which surviving young would have fledged were determined by projecting forward from the estimated average age of the young in each brood at the last nest box visit. Because the ages were not based on detailed measurements and the sample size was small, we used median rather than mean to indicate central tendency of the data. However, in 1977 and 1978 mean and median were only different by one day and mean and median were identical in 1979 and 1980. The number of nest boxes in Table 2 is smaller than noted in Table 1 as the ages of the young in nine boxes were not recorded.

Kestrel use of boxes averaged 31%, and 82% of these fledged at least 1 young (Table 1). An average of 3.1 young fledged per active box. The rate of productivity reported for other studies of the American Kestrel ranged from 2.3 to 4.4 (Hamerstrom et al. 1973, Nagy 1963, Smith et al. 1972, Craig and Trost 1979, and Stahlacker and Griese 1979). Of the 99 nestlings that were old enough to be reliably sexed, 47 were females and 52 were males.

Because not all boxes were examined at fledging, we can only estimate number of young actually fledged. However, based on the number of young known to have fledged per successful box (3.7) and nest succes (82%) for the 65 boxes (Table 1), we estimate that 197 nestlings were fledged over the four-year period.

Egg laying to fledging period spanned 112 days, between 6 May and 25 August for the 4 years (Table 2). Young fledged in 28-30 days. Nesting phenology was similar to that reported in southeastern Idaho (Craig and Trost 1979). Median egg laying, hatching, and fledging dates for the 4 years were 22 May, 21 June, and 21 July, respectively (Table 2).

TABLE 2

American Kestrel Laying-Hatching-Fledging Chronology, Lassen County, California

	1977 n=7	1978 n=11	1979 n=4	1980 n=5	All Years n=27
Median Egg Laying Date and Range	05/23 05/13-06-04	05/16 05/06-05/24	05/23 05/23-05/24	05/30 05/08-06/26	05/22 05/06-06/26
Median Hatching Date and Range	06/22 06/12-07/04	06/15 06/05-06/23	06/22 06/22-06/23	06/29 06/07-07/26	06/21 06/07-07/26
Median Fledging Date and Range	07/22 07/12-08/03	07/15 07/05-07/23	07/22 07/22-07/23	07/29 07/07-08/25	07/21 07/05-08/25

Unlike species that do not tolerate human disturbances (Fyfe and Olendorff 1976, Bloom 1974), we found that kestrels tolerated disturbance during the incubation period, if parents were allowed plenty of notice of our approach, and were allowed to fly from the box. In one instance, a nest may have failed due to an investigator who surprised an incubating female that kicked her eggs while assuming a defensive posture on her back. However, not all incubating adults responded this way, and some could be captured, banded, and replaced in the box without any loss of eggs or young.

Kestrels used only those nest boxes with unobstructed entrances and open to moderate, but never dense canopy coverage. Dead snags or live trees with open trunks or large gaps in the branches were most often used (Fig. 1). All types of supporting structures to which nest boxes were fastened were utilized, including white fir, ponderosa pine, aspen, cottonwood, and telephone poles.

Of 54 boxes used by kestrels where direction was recorded, 19 faced south, 17 north, 11 west, and 7 east. Failure rates for each direction were 10, 18, 36, and 14%, respectively. The high failure rate of west facing nest boxes may be due to the intensity of the afternoon sun.

Discussion

American Kestrels readily accepted our nest boxes and fledged young in habitat that was previously unoccupied. Although it was not possible to qualify the increased number of pairs as a result of nest box installation, we are confident, because of earlier searches, that most areas lacked nesting kestrels before we installed nest boxes.

Because many of the nest boxes were intentionally placed in less than optimum trees or habitat conditions, we feel that the number of breeding attempts could be substantially increased. Particularly important is the placement of the box on the edge of a forest or on a lone tree and not deep inside the forest. Another important factor was unobstructed flight paths to next boxes. The lower use of an artificial box in an earlier similar study, also in juniper in the Great Basin of Utah (McArthur 1977), appears to be a result of the latter two variables (C.M White pers. comm).

During our study kestrel use of nest boxes steadily increased from 20% in 1977 to 38% in 1980. We feel that with careful placement, nest box use by kestrels could easily reach 50% in the Great Basin habitats of California.

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